



Summary of the DISCOVER-AQ Campaign and Incorporation of the Results into MDE's O₃ Conceptual Model

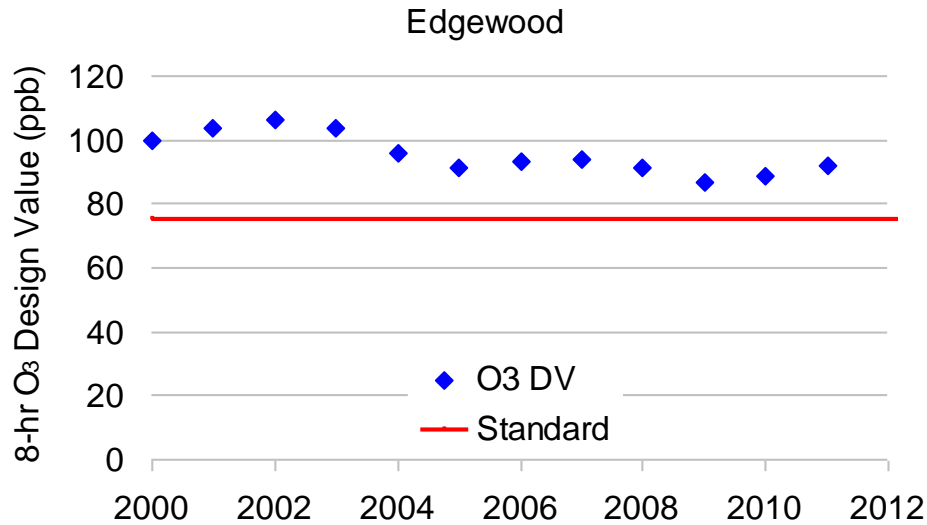
Jennifer Hains

Maryland Department of the Environment

National Air Quality Conference – Ambient Monitoring

May 16, 2012

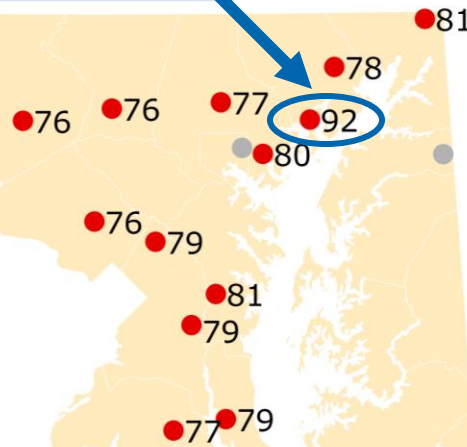
Introduction



Edgewood

MD 2011 Design Values

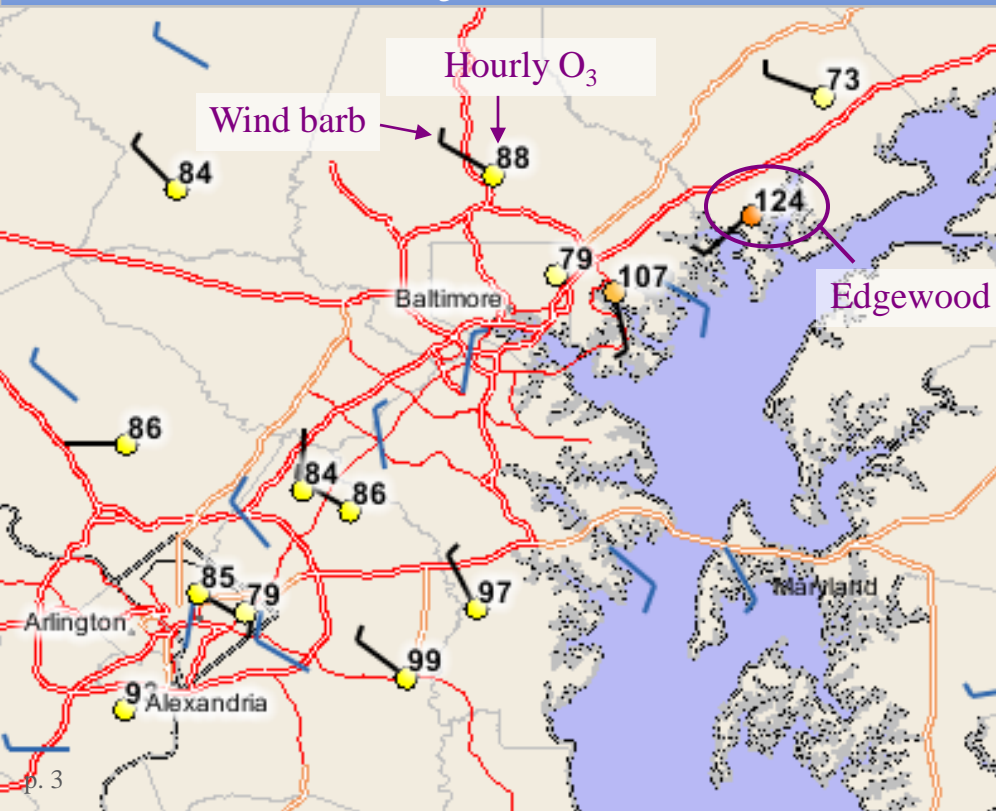
- Meet standard
- Exceed standard



- O₃ conceptual model – Qualitative look at O₃ sources and transport patterns as well as effectiveness of control measures.
- Most sites in MD exceed the O₃ 75 ppb NAAQS → Edgewood is the most problematic.
 - Downwind from Baltimore/Washington.
 - Nearby sources.
 - Westerly winds and bay breeze convergence zone traps pollution.
- We collaborate with nearby Universities to investigate O₃ events with aircraft and balloon launches.

The Edgewood Problem

Hourly O₃ on June 8, 2011



- ❑ The Baltimore NAA continues to struggle with the 8-hour O₃ NAAQS.
 - Edgewood is the “troublesome monitor”.
- ❑ In 2011 Edgewood reported 17 O₃ exceedance days.
- ❑ Edgewood influences:
 - Chesapeake Bay breeze - Caused by a sharp gradient between land and water temperatures.
 - Stagnation
 - Temperatures generally ≥ 90 F.
- ❑ DISCOVER-AQ provided multi-platform measurements to examine sources and transport of O₃.

Source: AIRNow-Tech



Deriving Information on Surface Conditions from Column and Vertically Resolved Observations Relevant to Air Quality

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DISCOVER-AQ

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Past Missions

Future Missions

Launch Schedule

Mission Calendar

DISCOVER-AQ

Diagnosing the Air We Breathe



DISCOVER-AQ Mission

A challenge for Earth-observing satellites measuring air quality is to distinguish between pollution high in the atmosphere and that near the surface where people live and breathe. This summer NASA begins a multi-year airborne field campaign to tackle this challenge.

The project is called DISCOVER-AQ, which stands for Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality.* NASA's Langley Research Center in Hampton, Va., is the lead center for the mission.

Discover-AQ Mission Updates

Flights Planned for Monday, July 11
17 hours ago

Flights Set for July 10 1 day ago

No Flights July 9 2 days ago

[View Archive](#)

Current DISCOVER-AQ Campaign

Baltimore - Washington, D.C. 2011

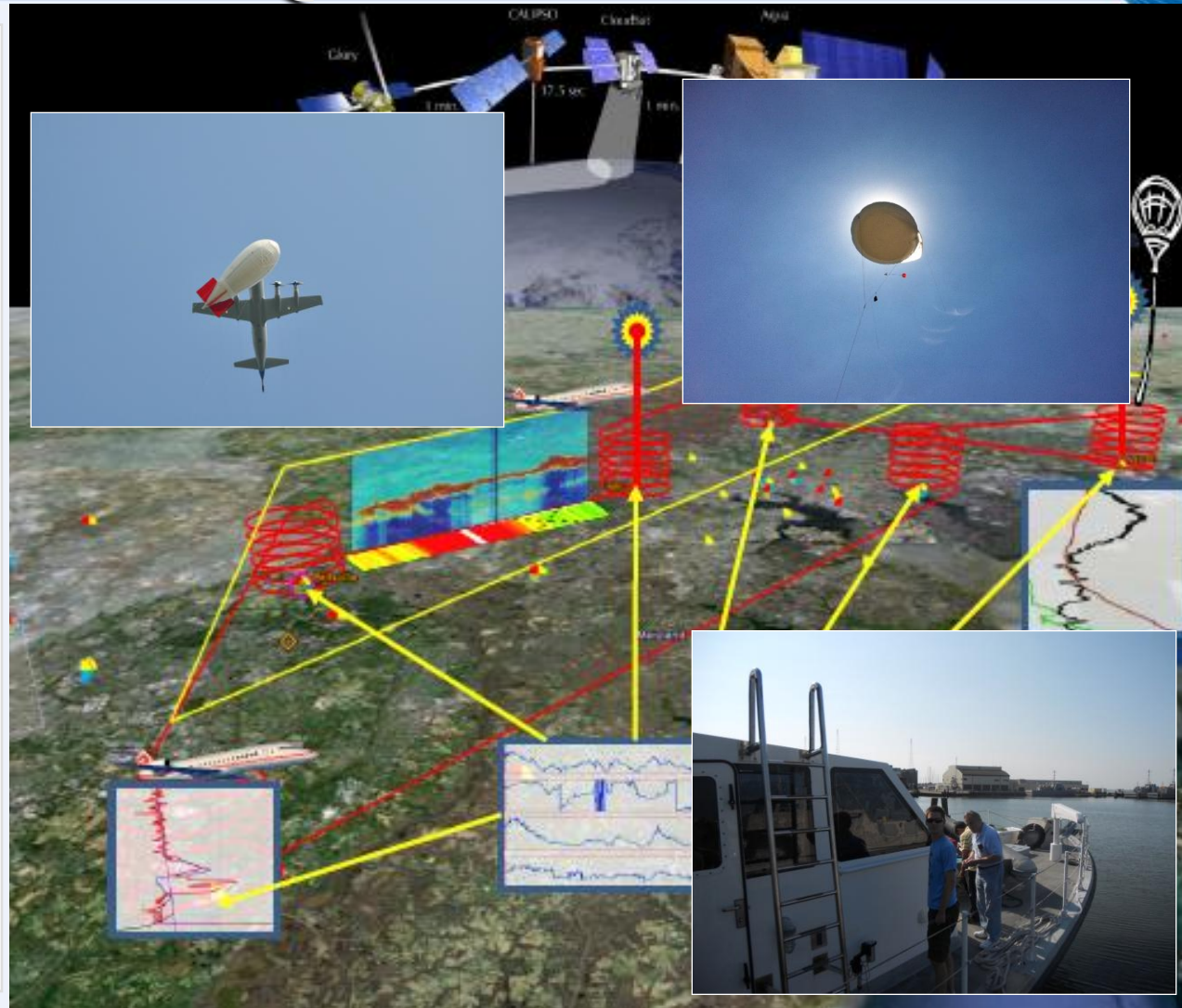
Monitor our flights in real time:

Science Team Website

[Visit the Science Team Webpage for more](#)

DISCOVER-AQ Measurements

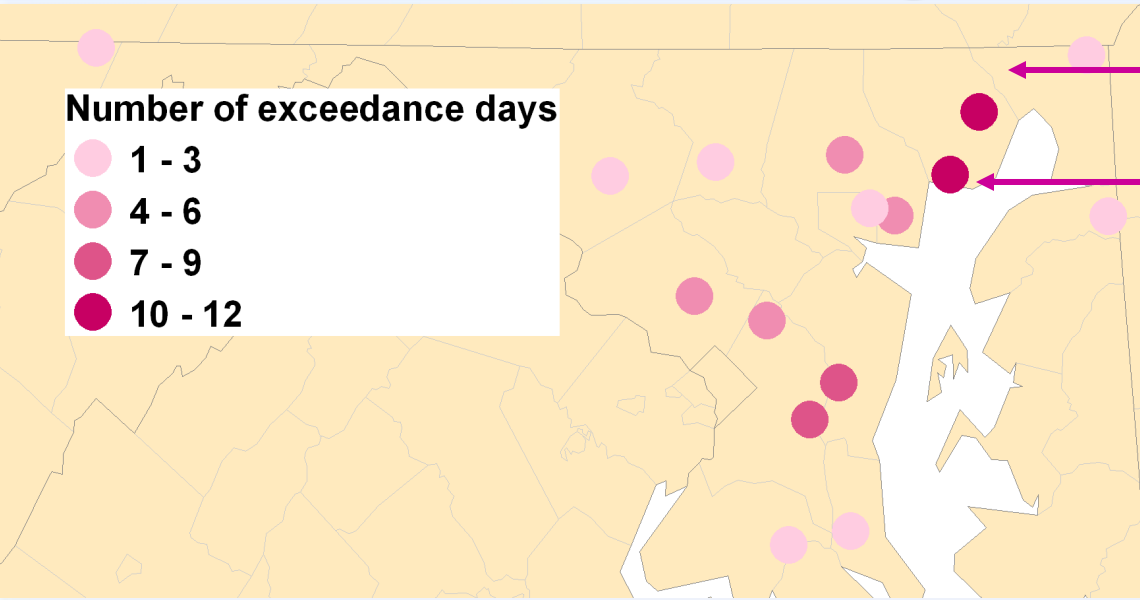
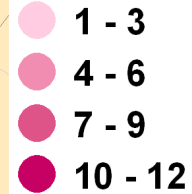
- ❑ Sampling conducted during July 2011, with 16 exceedance days.
- ❑ Observations
 - 3 aircraft – 254 spirals.
 - 6 surface sites
 - 4 aerosol lidars
 - 2 O₃ sonde locations
 - 1 tethered balloon
 - 1 ship



Courtesy: Jim Crawford, NASA

July O₃ summary

Number of exceedance days

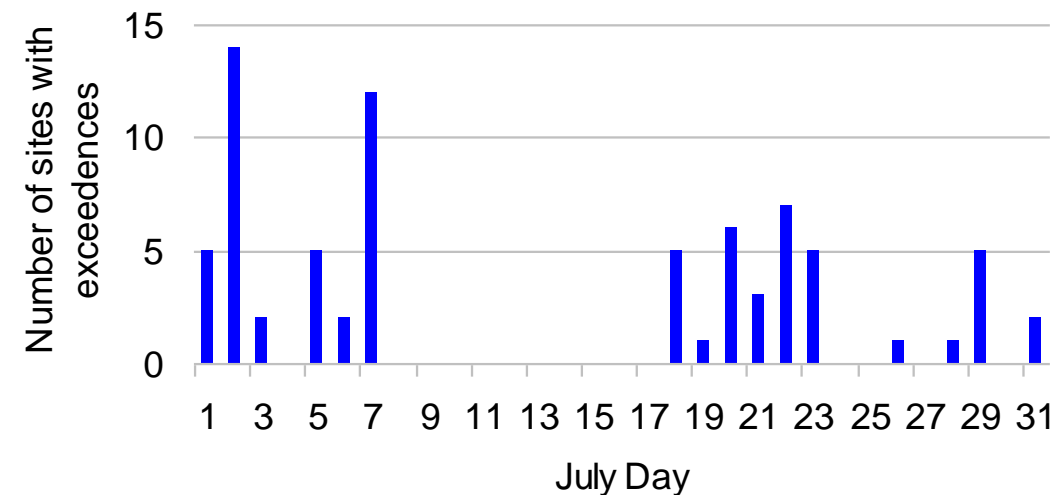


☐ In July Aldino and Edgewood had the most exceedance days (10 and 12).

☐ Edgewood had 3 code red days.

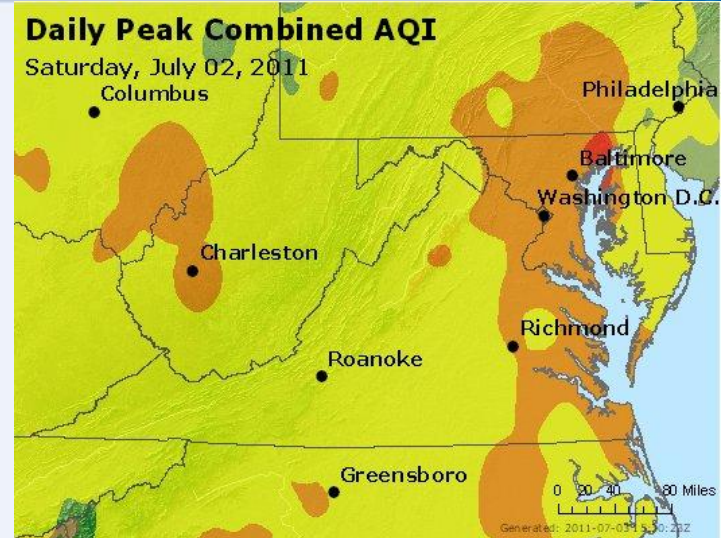
- 8-hr avg. > 96 ppb
- Examples: July 2 and 22.

8-hour O₃ exceedances in July

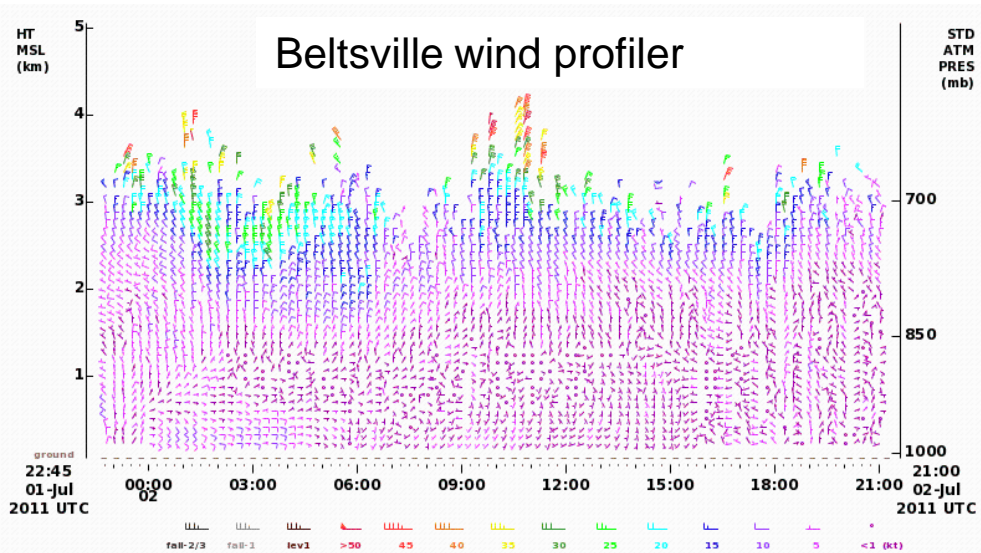
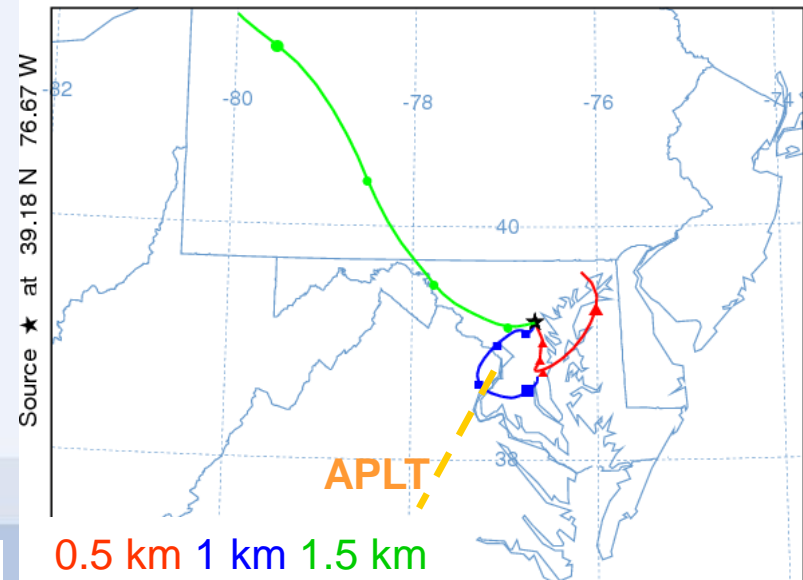


July 2, 2011

- ❑ Part of July 1-3 episode.
- ❑ Daily max 8-hour $O_3 \rightarrow 107$ ppb at Edgewood.
- ❑ Contributors:
 - High pressure system.
 - Max. temperature @ BWI at 91 °F.
 - Stagnant conditions throughout the day.
 - Appalachian Lee Side Trough (APLT).
 - Bay breeze.

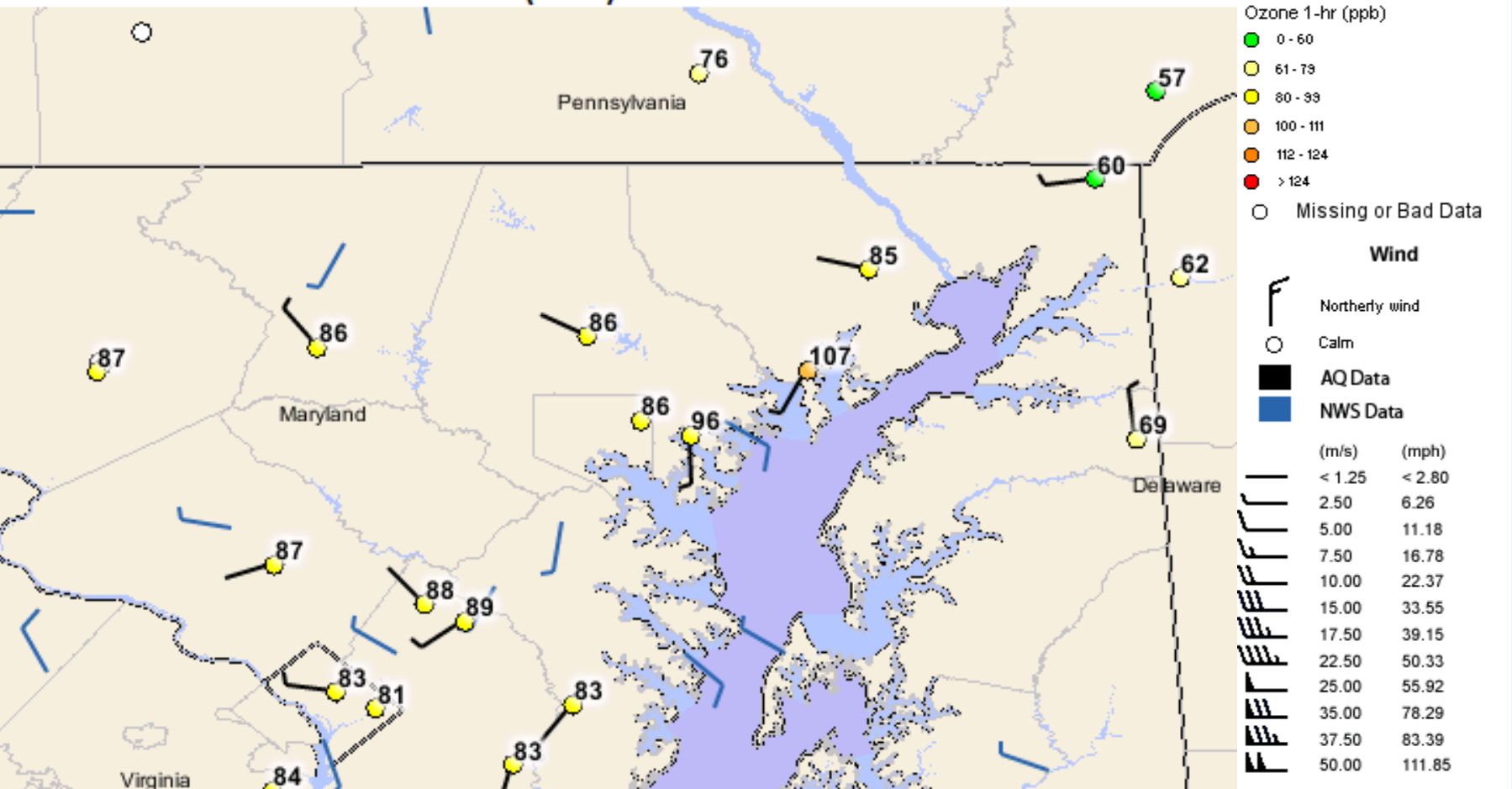


NOAA HYSPLIT MODEL
Backward trajectories ending at 2100 UTC 02 Jul 11
NAM Meteorological Data



July 2 Bay Breeze

AIRNow-Tech: O3 (PPB) for 07/02/2011 12:00 EST

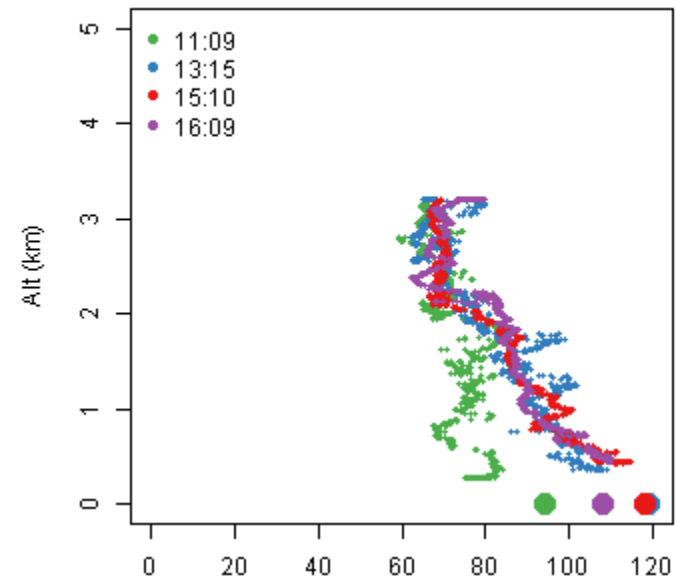
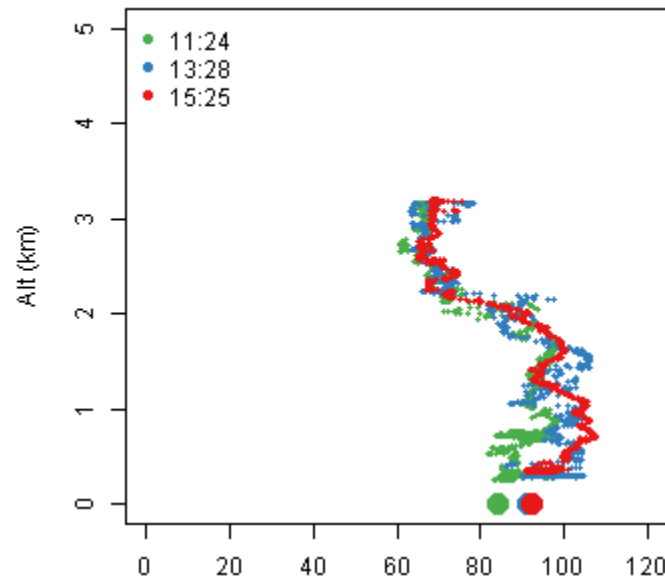
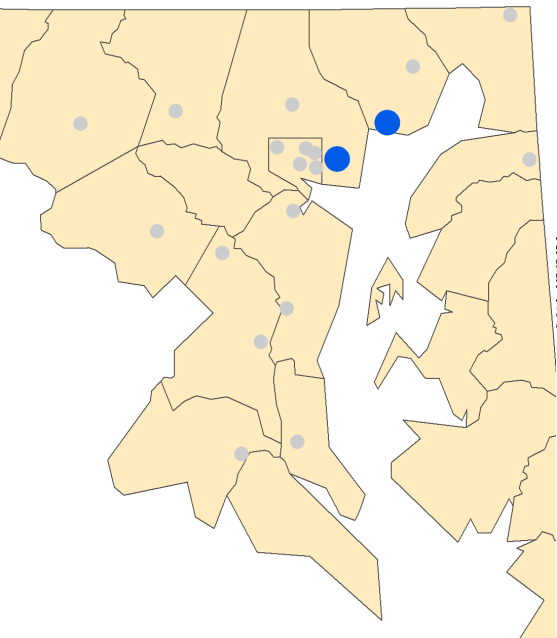


- Surface winds at Essex and Edgewood show onshore flow while winds at Padonia and Aldino show northwesterly winds.
- Sodar at Edgewood also shows onshore flow.



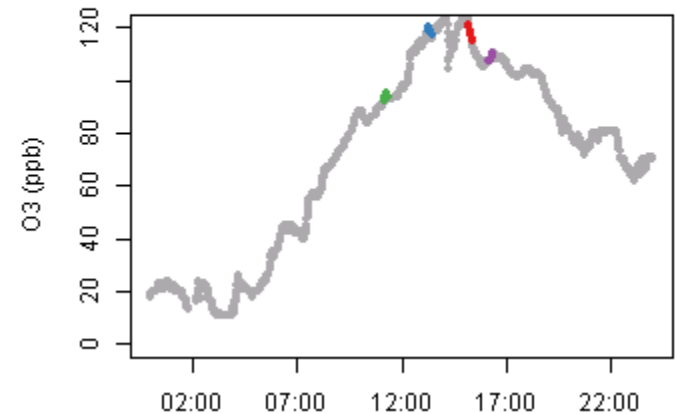
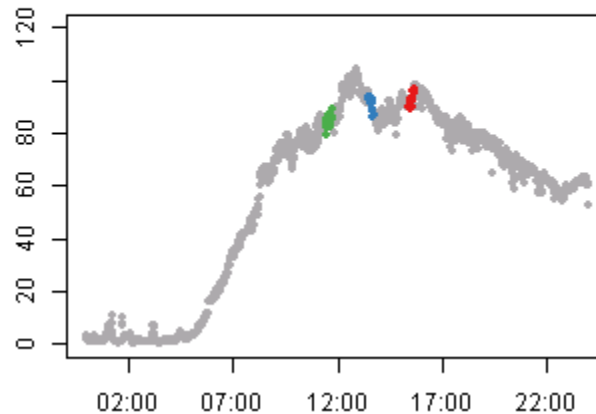
Bay breeze impacts Essex-Edgewood

- Stagnation leads to high O_3 around the region.
- Bay breeze contributes to code red O_3 at Edgewood and code orange at Essex.



Essex

Edgewood

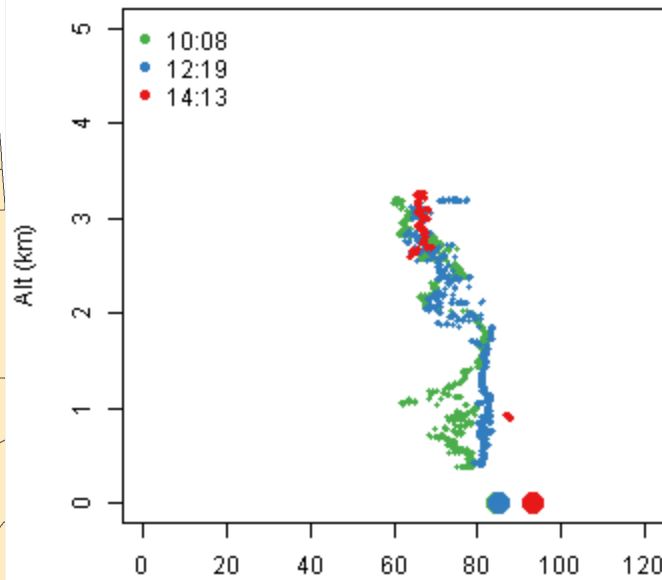
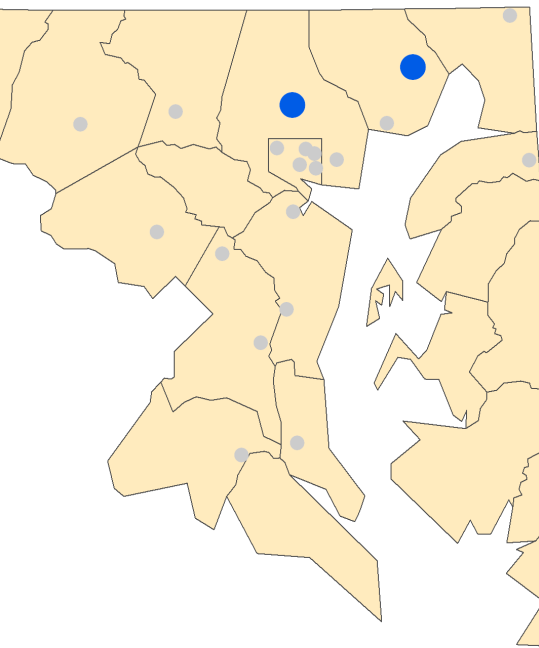


Essex → 87 ppb O_3 Code orange

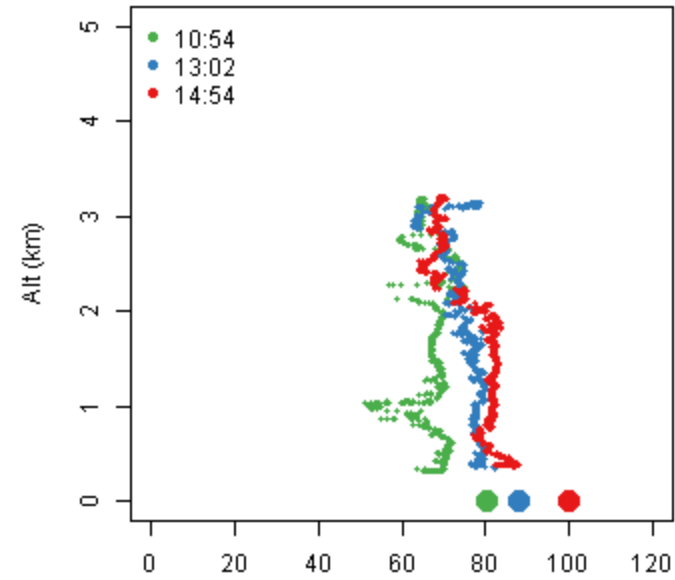
Edgewood → 107 ppb O_3 Code red

Time is EST

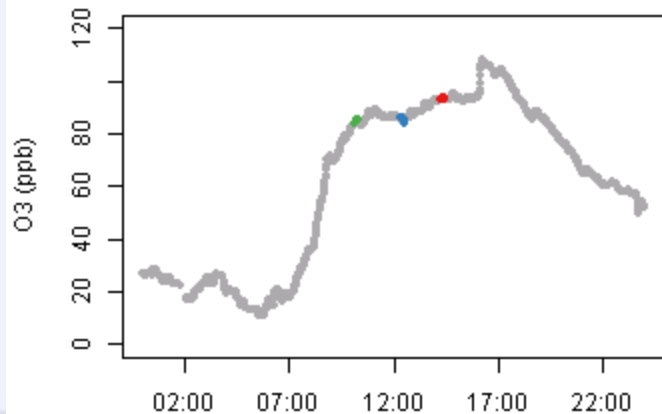
Bay breeze impacts Padonia -Aldino



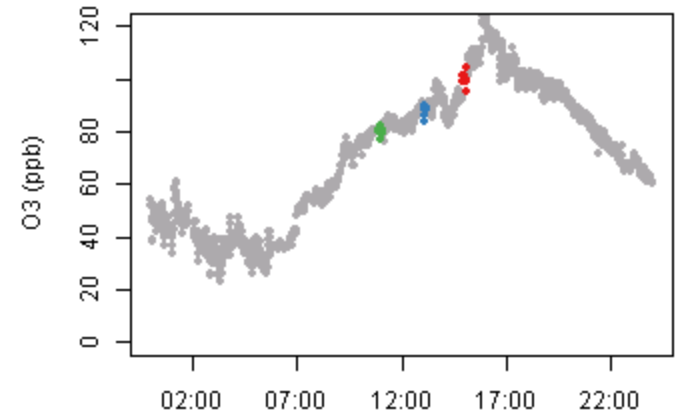
Padonia



Aldino



Padonia → 92 ppb O₃ Code orange



Aldino → 98 ppb O₃ Code red

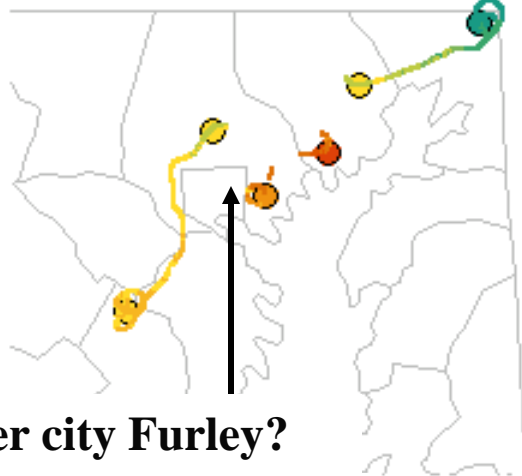
Time is EST

O₃ gradient in P3 transects

09:52 - 11:27 EST



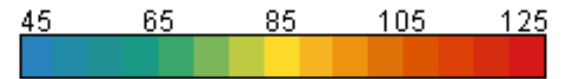
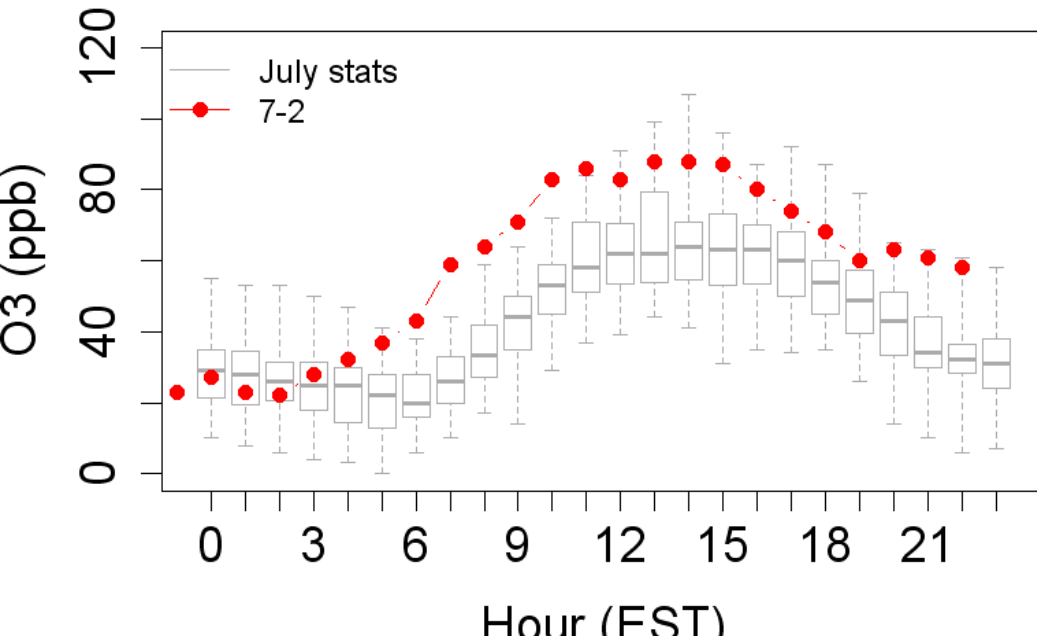
12:04 - 13:35 EST



14:02 - 16:21 EST



Could Bay breeze impact inner city Furley?



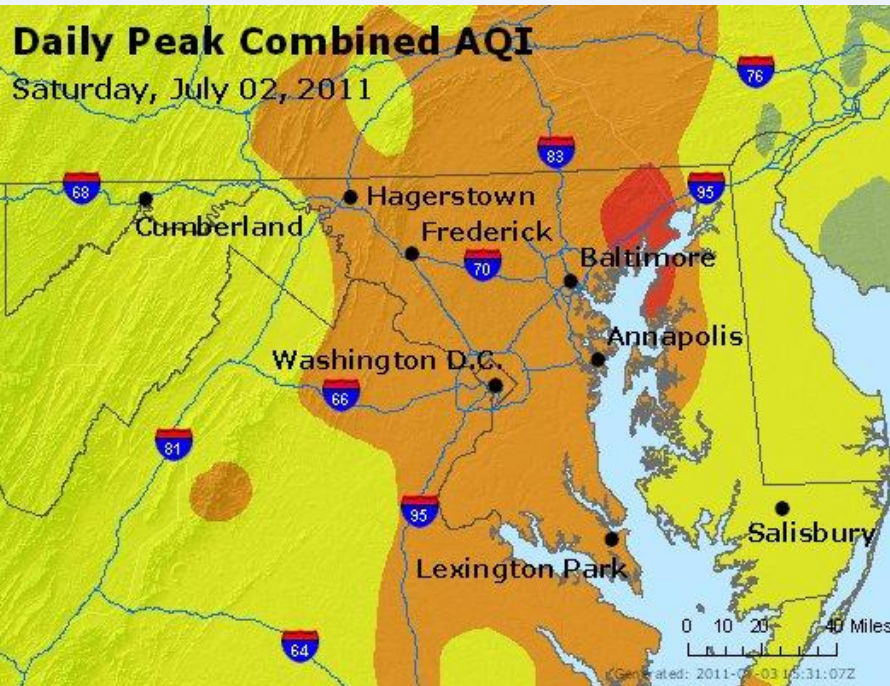
O₃ from P3 between 0.3 - 0.6 km

Surface O₃ circled in black.

July 22, 2011

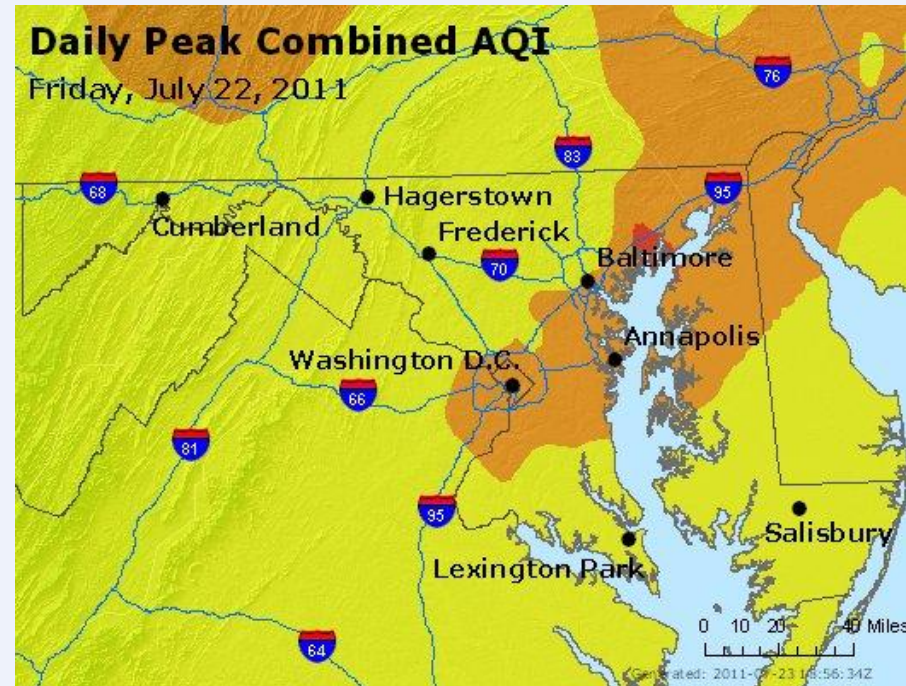
Daily Peak Combined AQI

Saturday, July 02, 2011



Daily Peak Combined AQI

Friday, July 22, 2011

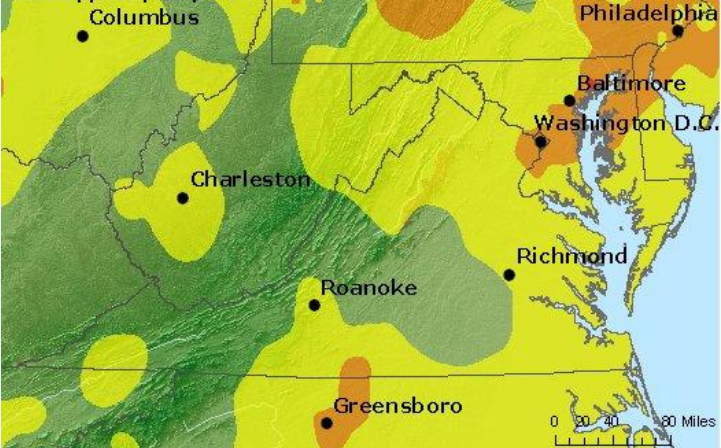


July 22- Code orange impacted a slightly smaller region than July 2.

July 22 - Overview

Daily Peak Ozone AQI

Friday, July 22, 2011



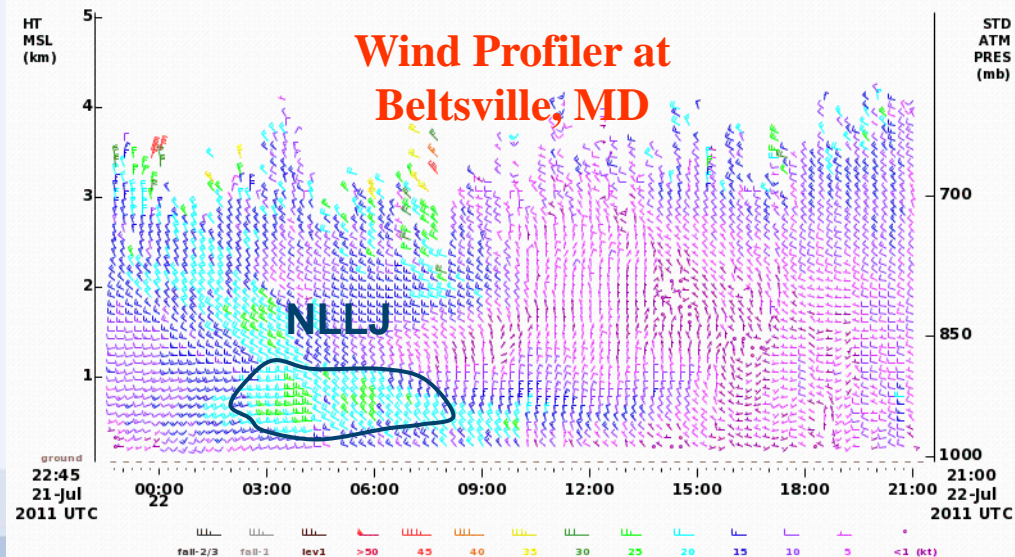
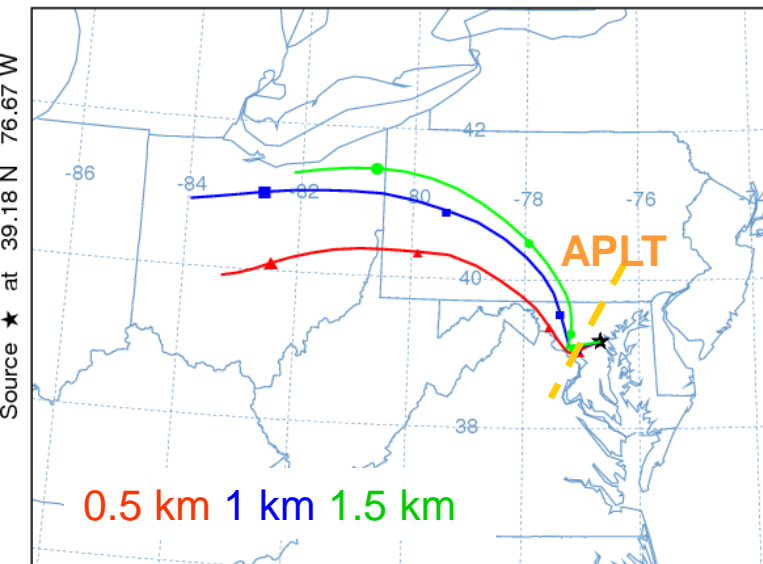
NOAA HYSPLIT MODEL

Backward trajectories ending at 2100 UTC 22 Jul 11

NAM Meteorological Data

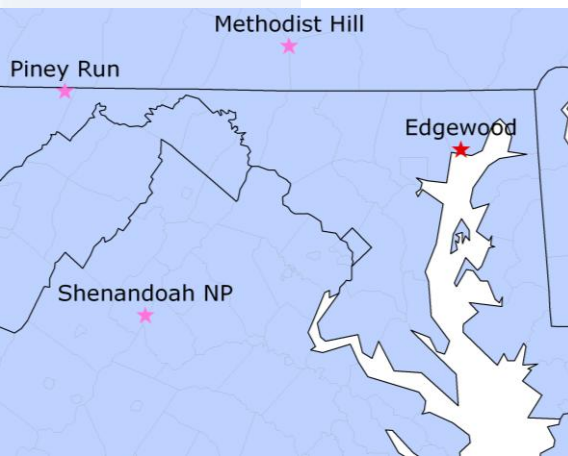
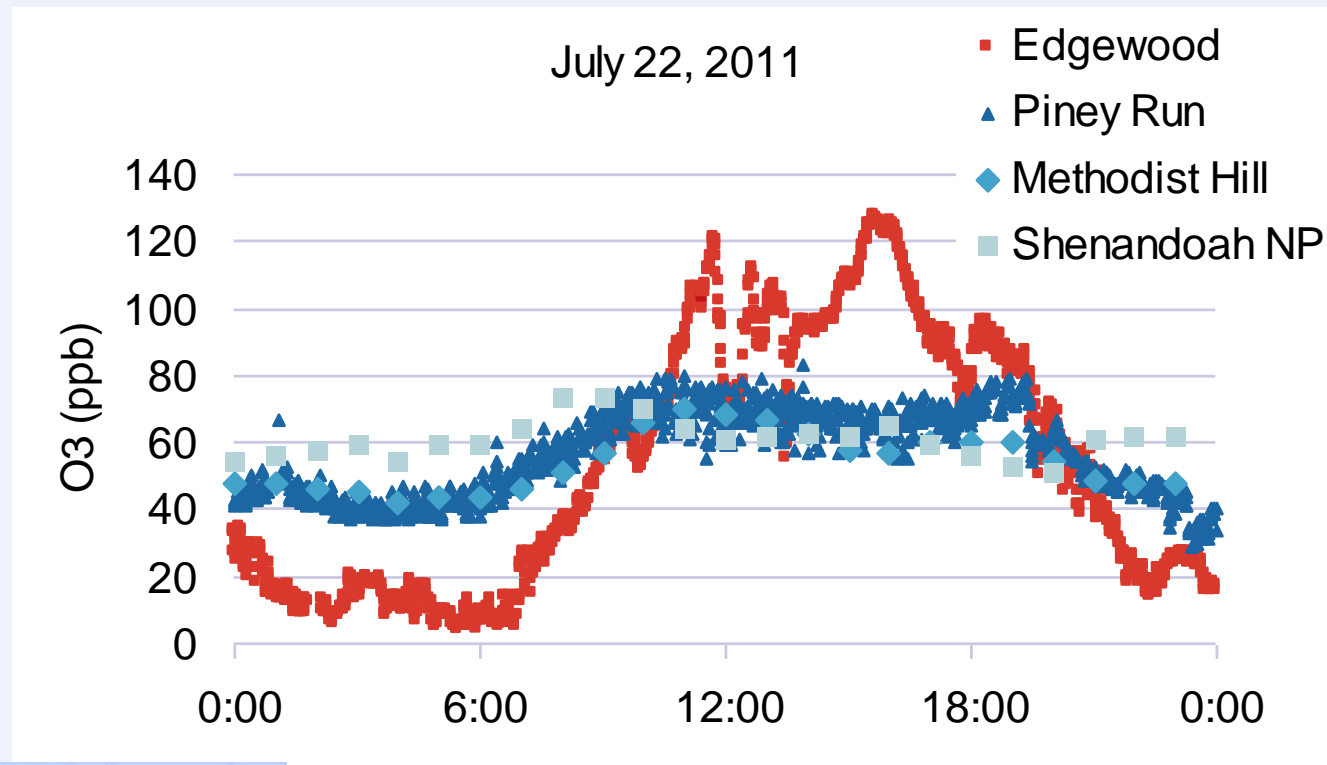
Primary meteorological features

- High pressure system off the coast.
- Max. temperature @ BWI at 106 F.
- NLLJ in the morning, stagnation in the afternoon.
- Transport regime was primarily from the west to northwest.
- An Appalachian Leaside Trough (APLT) near I95 corridor.





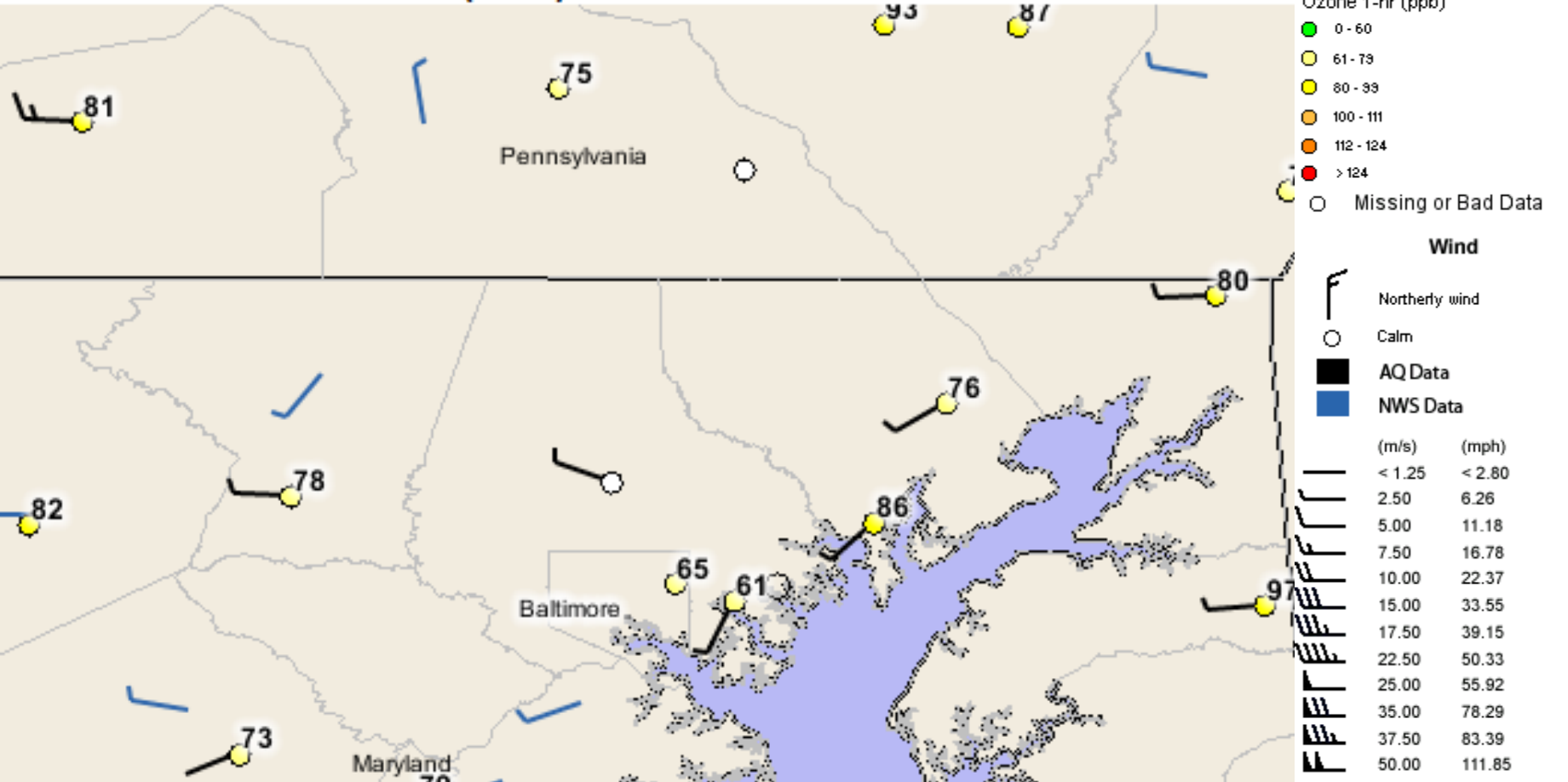
July 22- Transported O_3 into MD seen from Piney Run



Morning O_3 (50 ppb) at Piney Run and other elevated sites may have been transported to the Baltimore area and then mixed down.

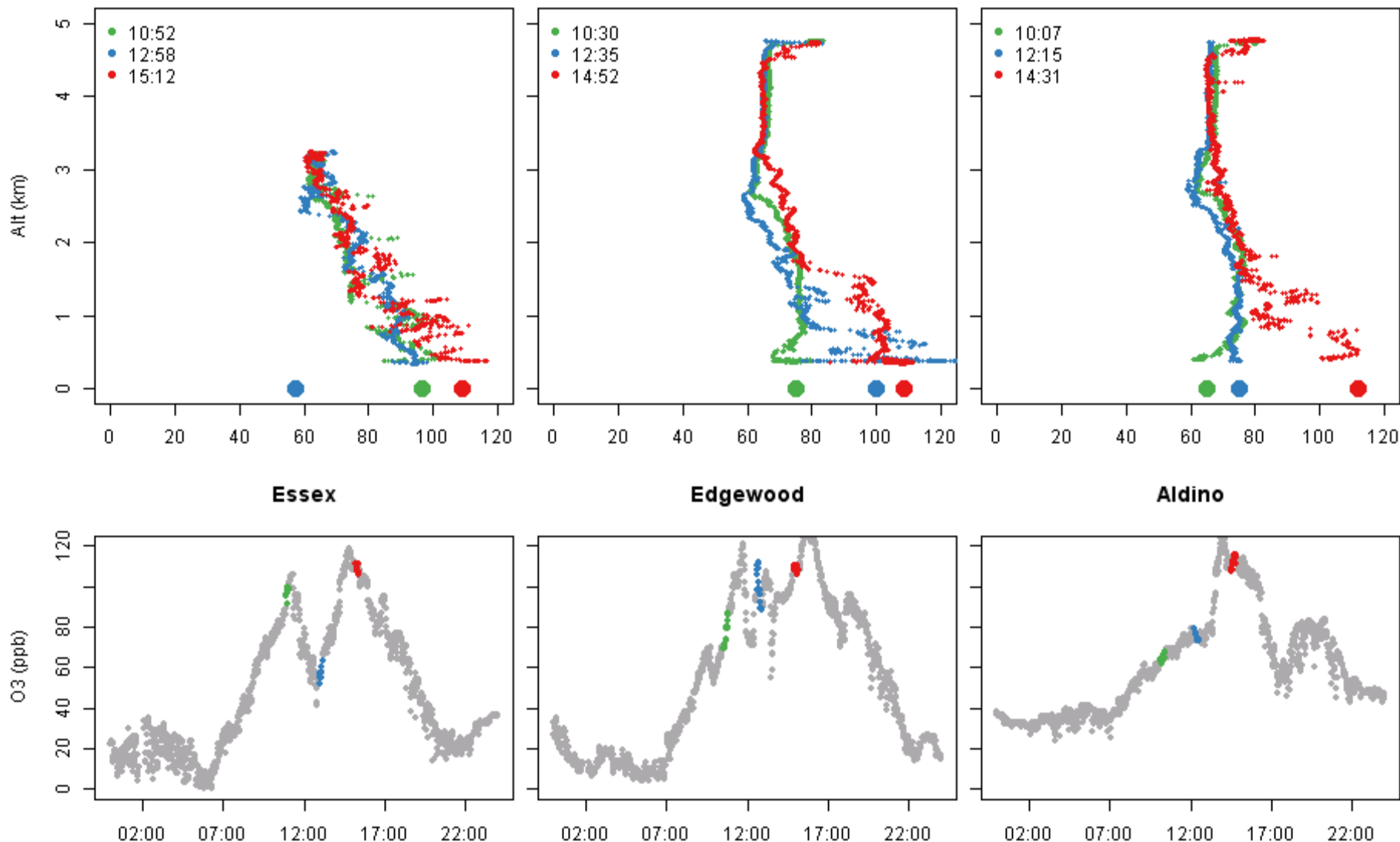
July 22 Bay breeze

AIRNow-Tech: O3 (PPB) for 07/22/2011 12:00 EST



Surface winds show bay breeze between Essex and Padonia.

July 22- P3 profiles



☐ Morning elevated O₃ may have mixed down by the afternoon.

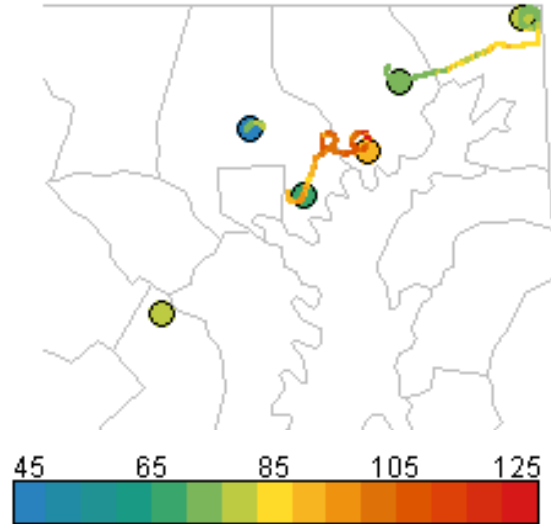
☐ Sharp O₃ decrease at noon (Essex, Edgewood).

July 22 P3 transects

09:03 - 10:53 EST



11:24 - 13:00 EST



13:26 - 15:44 EST



O₃ from P3 only between 0.3-0.6 km

Surface O₃ circled in black.

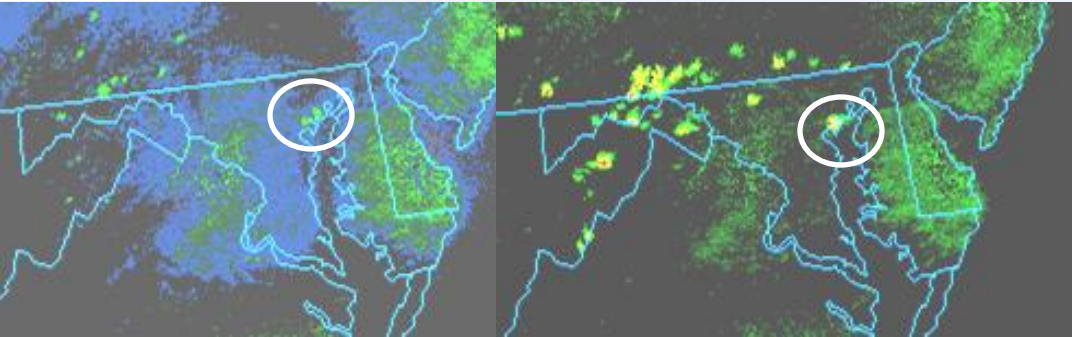
Morning elevated O₃ above Essex and Edgewood may have mixed down by afternoon.

July 22 - Thunderstorms

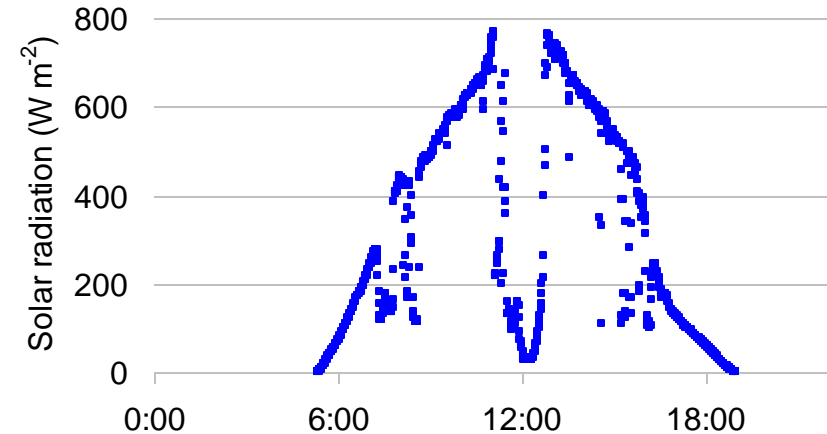
NEXRAD 1km

1130 EST

1230 EST



Essex July 22, 2011



- ☐ Bay breeze at Essex may have been the trigger for thunderstorms early in the day.
- ☐ Thunderstorm activity 1130-1230 EST.
 - Storm cells appear to extend to Edgewood.
 - Cloud cover blocked out sun and stalled O₃ formation.
 - Dissipated just before 13 EST.
- ☐ Once clouds cleared...
 - The bay breeze formed again near Essex.
 - O₃ was able to recover and reach high values later in the day.

Summary

- ❑ DISCOVER-AQ provided a wealth of data to examine O₃ exceedance days in Maryland.
- ❑ Aircraft, balloon and lidar observations help us understand pollution aloft and how pollution is transported into the region.
- ❑ We will continue to analyze the data and collaborate with nearby universities and federal agencies.



Contact

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